Low Delta-V Crashes Resulting in Serious Injury

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Questions

When occupants are seriously injured at low delta-v's, what contributes to the injury causation?

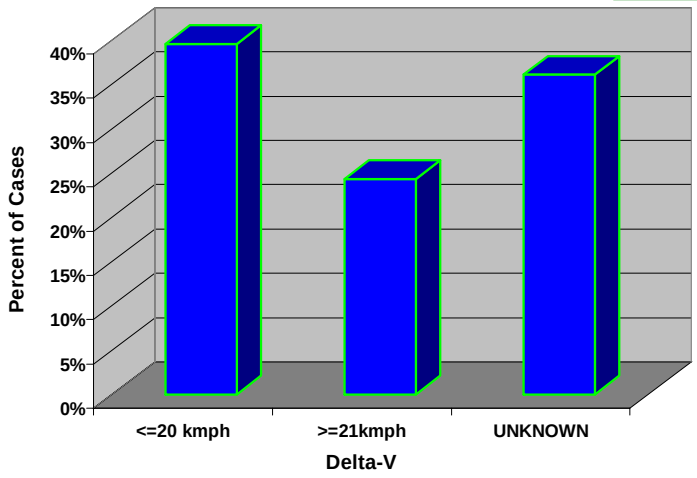
What details are required to better analyze this issue?

What does the field data tell us?

NASS Data

Criteria
Ages 18+
Rollovers excluded

CDS Data (98-05) Delta-V Distribution



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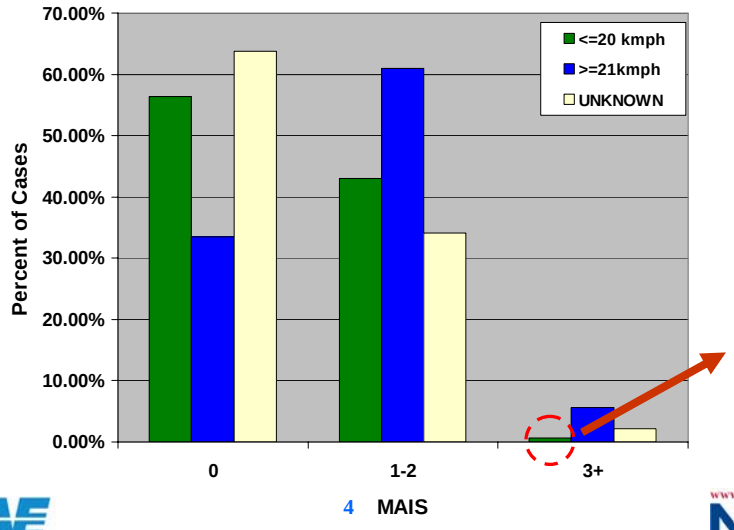
NASS Data

Criteria
Ages 18+
Rollovers excluded

CDS Data (98-05) Delta-V and Injury Severity



52,967 Occupants

12,180 Fatals

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Study Group Inclusion

Step 1

- CIREN cases 1997–present
  - Occupant must sustain an AIS3+ injury
  - Ages 18 and up
- Winsmash DV <=20 kmph (12.4 mph)
- N=132
- Delete any vehicle with a rollover (9)
- N=123
- Delete any “Special Interest” cases (1)
- N=122

Review Vehicle Damage

Crash investigator’s estimate of Winsmash validity
(Delta-V versus Crush and/or Intrusion)

10 mph ?

8 mph ?

12 mph ?

Low Estimates Dropped

- Typical crashes of concern
  - FLEE's & FREE's
  - Narrow impacts with fixed objects
  - Angled side impacts
- 43 (35%) cases rated as "low estimate"
- N=79

Optimal Restraint Use

- Only restrained occupants included
- Belt restrained or air bag and belt restrained
- Unbelted occupants excluded
  - Regardless of Air bag deployment
  - 21 occupants removed
- Occupants with documented belt misuse
  - 2 occupants removed
- N=56

Acceptable

Crash conditions and damage appear appropriate

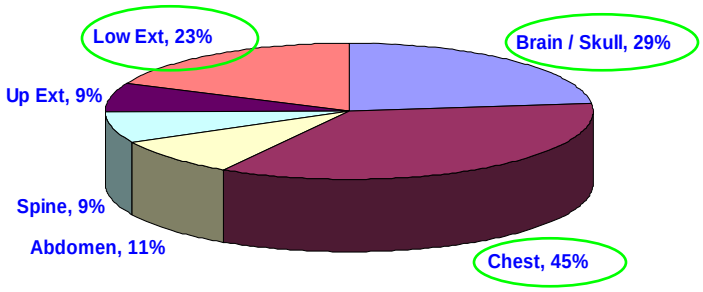
Category	Occupants	Percent
Crash Type		
Frontal	20	36%
Side	36	64%
Opposing Object		
Vehicle	48	86%
Fixed Object	8	14%
Vehicle Model Year		
1998 and later	33	59%
Restraint Status		
Belted	56	100%
AB deployed	35	62.5%
Fatalities		
Due to injury	4	7%
Due to disease	1	2%
Gender		
Male	28	50%
Female	28	50%

Group Stats

Category	Mean	Min	Max
DV kmph (mph)	16 (10)	9 (6)	20 (12)
Age	61	18	93
MAIS	3.4	3	5
ISS	17	9	54
Height cm (in)	170 (67)	147 (58)	198 (78)
Weight kg (lb)	79 (175)	42 (93)	123 (271)
TLOS (days)	8	0	30

Occupant Injury Distribution

AIS 3+ Injury by Body Region



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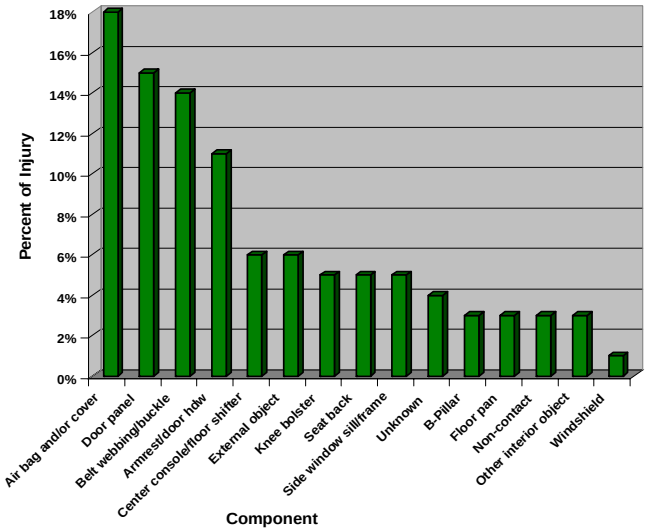
*56 occupants with 102 AIS3+ injuries

AIS 3+ Injury Source



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Contributing Factors

All cases manually reviewed for factors influencing injury causation and severity (Bio-Tab method)

- Age (Elderly)
  - Poor bone quality (osteoporosis)
  - Calcification of vascular structures
- Intrusion
  - Intruded component causes or exacerbates injury
- Pre-morbid Condition
  - Medical condition affecting injury causation
    - Medications, obesity, implants (ortho/organ)
- Multiple Impacts / Out of Position
  - Occupant's injury impact position is non-optimal

Contributing Factors

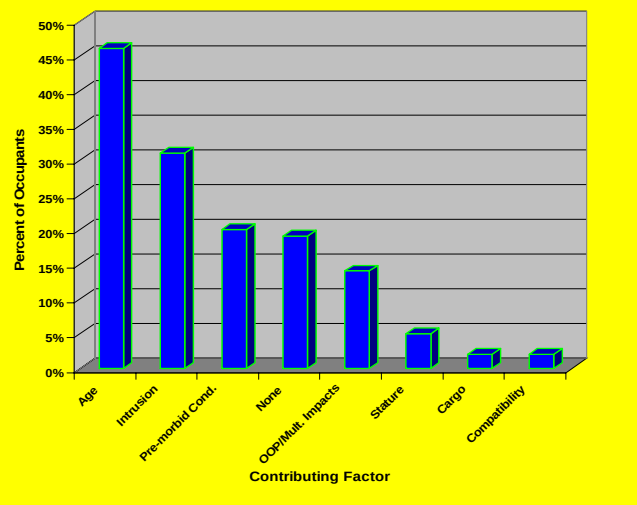
Continued

All cases manually reviewed for factors influencing injury causation and severity

- Stature
  - Occupant proximal to injurious components
    - Seat track, seated height
- Compatibility
  - Striking vehicle's height or stiffness is a factor
    - Usually coded as intrusion, head contact to V2
- Cargo
  - Cargo shifting or moving in the vehicle is a factor
    - Equipment, pets (large)

Contributing Factors Distribution

(Several can apply)



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Fatal (crash)

4 cases were fatal

All case vehicles were pre-1998

Case 1

- **77** y.o. male, frontal impact, SDH-AB
  - Out of position, age and PMH

Case 2

- **67** y.o. male, frontal impact, cerebral bleed-AB
  - Age

Case 3

- **77** y.o. male, frontal crash, cerebral bleed-Medicine cabinet
  - Cargo

Case 4

- **91** y.o. female, side impact, liver lac-Armrest
  - Intrusion and age

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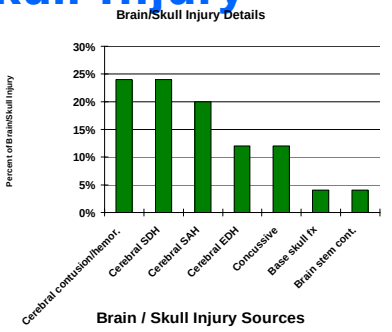
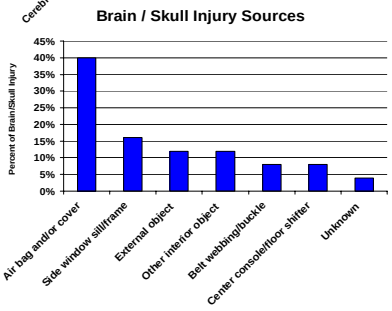
Brain and Skull Injury

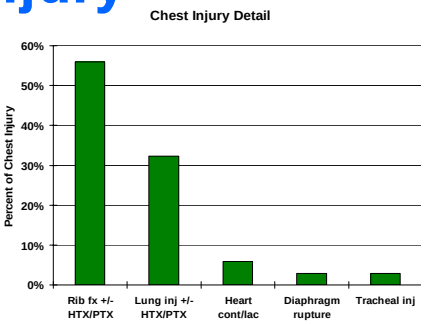
- 16 Occupants with AIS3+ brain or skull injury (25 injuries)
- 17 kmph avg. (10.6 mph)
- Majority of brain injury are cerebral bleeds
- Primary source air bag and or related components
- 44% (7/16) of the occupants were in 1998 or newer vehicles
- 66% (4/6) of the occupants with AB sources were in 1997 and older vehicles
- Avg. age of group=69 - AB group=72

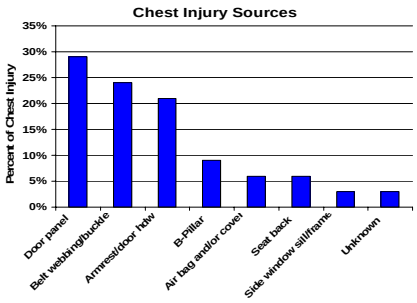




Chest Injury

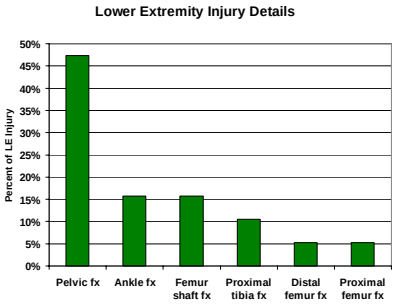
- 25 occupants with AIS3+ chest injury (34 injuries)
- 15 kmph avg. (9.3 mph)
- Rib fractures, HTX, PTX and lung contusions are high frequency
- Door, armrest and belt are the primary sources
- 68% (17/25) of the occupants were in 1998 or newer vehicles
- Avg. age of chest group=61

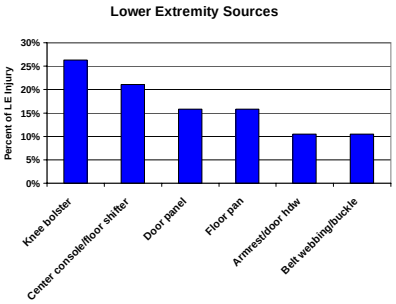




Lower Extremity Injury

- 13 occupants with AIS3+ LE injury (19 injuries)
- 17 kmph avg. (10.6 mph)
- 54% (7/13) occupants were in side impact crashes
- Pelvic fractures dominate the LE AIS3+ group
- Source is not isolated
- 62% (8/13) occupants were in 1998 or newer vehicles
- Avg. age of LE group=**55**

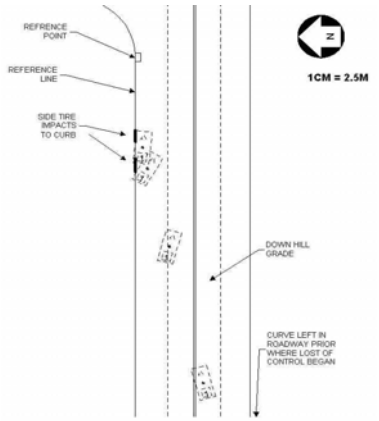




Examples

Case – No Contributing Factors

- Case V = 1998 Jeep Wrangler
- Crosses center line, bumps curb and strikes 1991 Plymouth Acclaim
- PDOF = 0
- DV=18 kmph



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No Factors

- 41 y.o. male driver
- Belt and air bag
- No past medical
- Interview – good recall
- No intrusion
- Min. crush

No Factors

- Right femur shaft fx
- IM rod surgical repair
- TLOS = 4 days
- Initial charges = $20,686.00

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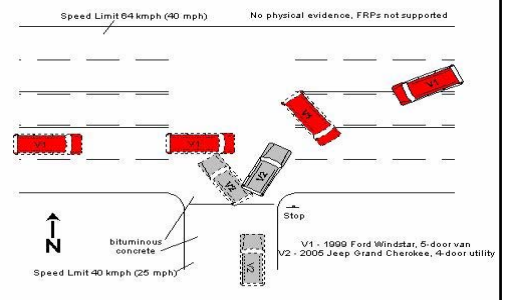
Case – Contributing Factors

- Case V – 1999 Ford Windstar van
- V2 – 2005 Jeep Grand Cherokee
- T-intersection crash
- Nearside configuration
- PDOF – 1 o'clock (30°)
- DV = 11 kmph (7 mph)



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Case – Contributing Factors

- 62 y.o. male right front passenger
- Pre-morbid conditions
  - Aortic aneurysm
  - Cancer
  - Smoker (1 PPD)
  - Anemic
  - Hypertension
  - Atherosclerosis (aorta/coronary)
- Belted – no air bags deployed
- 5 cms related intrusion
- 17 cms crush

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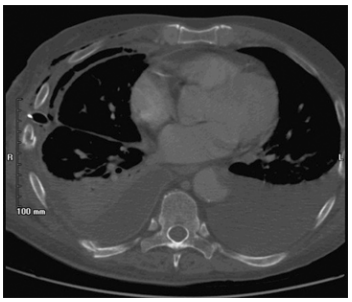
Case – Contributing Factors

- Right rib fxs (7-12)
  - Postero-lateral
  - Flail chest
- Right lung contusion
- Right pneumothorax
- Right lung laceration
- Liver laceration (small)
- MAIS=4
- ISS=20



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Case – Contributing Factors

- Initial hospital stay of 21 days
- Multiple respiratory complications
- Readmission 3X = 26 days additional
- Occupant expired before 12 month F/U
- Medical charges 47 days = $171, 037.00

Findings from CIREN Data

- Serious injury at low impact speeds
  - Primarily an older occupant issue
  - Not always
- Contributing Factors
  - Must be captured and documented in detail
- Intrusion
  - Much lower than current triage protocol
- Detailed past medical history
  - Indicators for increased severity
  - Multiple possibilities can apply

Next Steps - CIREN

- Bio-Tab coding to relate contributing factors directly to specific injury
- Continue to better define elderly
- New side impact vehicle investigation techniques
  - Improved intrusion, contacts and SAB data
- Utilize DICOM images
  - CIREN and other populations
  - Document anatomical changes

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Thank You

Questions?